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1. INTRODUCTION

Positron emission tomography (PET) is widely used for the study of human cerebral activity. As PET images do not reflect brain anatomy of patients, functional areas identified in such examinations cannot be localized precisely. Thus, a matching between PET and anatomical data from other sources is necessary to make the most of PET images. An approach to this problem is the direct recognition of cortical sulci on 3D magnetic resonance images (MRI) in order to build an accurate parcellation of brain for the localization of functional areas found in PET examinations.

2. AN INDIVIDUAL MODEL OF CORTICAL TOPOGRAPHY

The idea is to extract a statistical model of cortical topography from a database composed of MR images where voxels belonging to some major sulci have been identified. The computed model should then be used for sulci identification on other brain images.

The main point is that a single model cannot be built once for all: extracted data must be individually adapted to each MR image under examination. As a matter of fact, sulci features depend on the shape and size of the different brains contained in the database, which are very variable [2]. Therefore, those characteristics cannot be statistically merged in order to be used for sulci identification in another image. To tackle this issue, a correction mechanism is proposed. The coordinates of the points belonging to sulci contained in the database are converted into the coordinate system of the image where recognition has to take place, by means of Talairach's proportional grid [3]. Next, a set of features is extracted so as to represent the cortical topography. Thus, data are homogeneous because they are computed in the same anatomical coordinate system. Moreover, they take into account the brain characteristics of each patient.

To build a model of the cortical topography of the brain under examination, geometrical features are computed for each sulcus of the database (localization, direction, length, depth and straightness). For each couple of sulci appearing in the same database image, geometrical and topological relations are also determined (connectivity, relative orientation and localization). Statistics on each extracted feature are finally computed.

3. IDENTIFICATION OF SIX MAJOR SULCI

Precentral, central, postcentral, lateral, superior frontal and superior temporal sulci in both hemispheres are currently recognized. To identify these sulci in an MR examination, a processing is applied on the MR image so as to obtain the superficial part of the whole sulci as a set of 3D digital curves. Next, some of these curves are identified as parts of the sought sulci. This recognition is performed by means of the topography model computed from the database described in §2. A detailed description of our identification method can be found in [1], in the case of lateral sulcus. Finally, a recurrent voxel following is performed from the previously identified parts of the sulci in order to find missing voxels in deeper and deeper layers of the brain. The result is a thin and continuous 3D surface for each one of the recognized sulci.

4. RESULTS AND PERSPECTIVES

The superficial identification process has proved to be robust and efficient, since more than 90% of the sulci are correctly recognized on 13 MR images. The 3D identification step is still under improvement. Though its results need to be validated by neuroanatomists, they seem to be very promising.

Other improvements are also planned, such as the development of a unique identification protocol for all sulci, the extension of the sulci model in order to take into account ramified structures, or the building of a more declarative representation of processes so as to improve identification flexibility.

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